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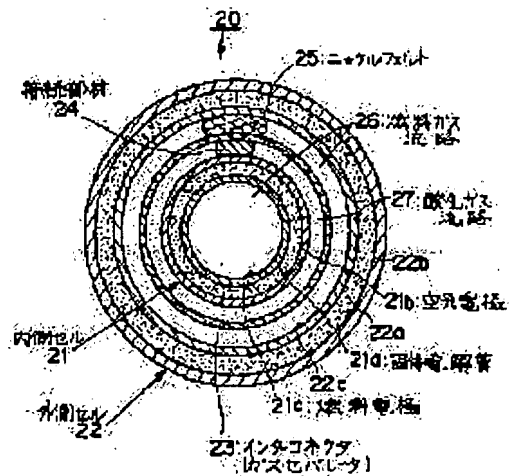
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(54) CYLINDRICAL LAYER-BUILT FUEL CELL

(57)Abstract:

PURPOSE: To coaxially dispose a plurality of cylindrical cells.

CONSTITUTION: Let an inner cell 21 where an fuel cell 21c is formed in either one of the inner circumferential surface or the outer circumferential surface of a cylindrical electrolyte 21a, and an air electrode 21b is formed in either of the other sides, and an outer cell 22 be coaxially disposed at a specified interval, and concurrently a space between both the cells 21 and 22 is electrically connected with each other via an elastical conductive member 25. Each cylindrical cell is planned to be increased in output and stiffness, concurrently it is made easy to manufacture, and the occurrence of damages and faulty contact because of the difference in thermal expansion is also prevented.



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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] This invention is a solid oxide fuel cell, and relates to the cylinder laminating mold fuel cell which arranged concentrically two or more single cells of a cylindrical shape in piles.

[0002]

[Description of the Prior Art] A solid oxide fuel cell sandwiches solid electrolytes with for example, oxygen ionic permeability, such as yttria stabilized zirconia (YSZ) and calcia fully stabilized zirconia (CSZ), prepares the fuel electrode which makes a subject the air electrode which consists of a perovskite mold lanthanum system oxide, nickel, etc., and acquires electromotive force by making the air and fuel gas which each of this electrode is made to face and are passed react electrochemically through a solid electrolyte.

[0003] Drawing 5 is what shows the conventional monotonous mold fuel cell 1. On one side face (it sets to drawing 5 and is an inferior surface of tongue) of the plate-like solid electrolyte 2 for example, the air electrode 3 While piling up airtightly through the gas separator 6 equipped with the slot which serves as a gas passageway to both sides in the plate-like single cells 5 and 5 of two sheets which formed the fuel electrode 4 in other side faces, respectively In the inferior surface of tongue of the lower plate-like single cell 5, and the top face of the upper plate-like single cell 5 The gas separators 7 and 7 which equipped one side with the slot used as a gas passageway are arranged so that the electrodes 3 and 4 of the front face of a solid electrolyte 2 may be touched airtightly. The slot of gas separators 6 and 7 which the slot of gas separators 6 and 7 facing the air electrode 3 of each ** cell 5 became the oxidation gas passageway 8 to which air circulates, and faced the fuel electrode 4 serves as the fuel gas passage 9 where fuel gas circulates. Thus, while the air which flows in contact with the air electrode 3 with gas separators 6 and 7, and the fuel gas which flows in contact with the fuel electrode 4 are separated so that it may not contact directly, electromotive force has been acquired by making it react electrochemically through the solid electrolyte 2 of said single cell 5. And by carrying out the laminating of many plate-like single cells 5 on both sides of a gas separator 6 in this way, and enlarging a module, it can be made the high voltage and can take out.

[0004] Drawing 6 is what shows the conventional cylindrical fuel cell 10 which connected and carried out the modularization of two or more cylindrical single cells 15 to direct and juxtaposition. Moreover, the cylindrical single cell 15 The air electrode 12, the solid electrolyte 13, and the fuel electrode 14 are formed outside in piles in order from the inside at the periphery of the porous hanger tube 11. The interconnector 16 which consists of metals, such as nickel which deleted the solid electrolyte 13 of them and some fuel electrodes 14, and was excellent in thermal resistance on the air electrode 12, is formed. And while connecting with a serial between a bus-bar 17 and 17 through the nickel felt 18 through which it flows possible [absorption of the dimensional change by thermal expansion], each cylindrical single cell 15 While flowing through between the fuel electrodes 14 and 14 of the outside of the adjoining cylindrical single cells 15 and 15 by the nickel felt 18, connecting also with juxtaposition and circulating air to the centrum of the cylindrical single cell 15 Fuel gas was circulated in the periphery

section in which the fuel electrode 14 of each ** cel 15 was formed, and electromotive force has been acquired by making it react electrochemically through a solid electrolyte 13.

[0005]

[Problem(s) to be Solved by the Invention] Although the high voltage could be efficiently obtained by gathering many plate-like single cels 5 in the case of the former conventional monotonous mold fuel cell 1 mentioned above, and enlarging a module, since the reinforcement of each component at the time of enlarging was not not much strong, there was a trouble of being easy to damage.

[0006] Moreover, since rigidity was high in the case of the latter conventional cylindrical fuel cell 10, the modularization was easy, but since each cylindrical single cel 15 had been independent, there was a problem that cell resistance became high.

[0007] Rigidity is high and this invention aims to let it for enlargement of a modularization etc. offer the solid oxide fuel cell of an easy cylinder product type, while being made in view of the above-mentioned situation and obtaining the high voltage efficiently.

[0008]

[Means for Solving the Problem] In order to solve the above-mentioned technical problem, it sets to this invention. While equipping with a fuel electrode either of the inner skin of a solid electrolyte and the peripheral faces which were formed in the cylindrical shape and equipping any or another side with an air electrode, respectively It is made to be the same as that of this cylindrical shape cel on the outside of the cylindrical shape cel equipped with the fuel gas passage which circulates fuel gas possible [contact] to said fuel electrode, and the oxidation gas passageway which circulates oxidation gas possible [contact] to said air electrode. It is characterized by connecting electrically to an inside cylindrical shape cel the cylindrical shape cel which adjoins [cel / which was formed in the major diameter one by one possible / loosely fitting / cylindrical shape] an inside cylindrical shape cel outside further in two or more [-fold], respectively through the conductive member which has elasticity.

[0009]

[Function] To either of the inner skin of a solid electrolyte and the peripheral faces which were formed in the cylindrical shape by constituting as mentioned above, an air electrode While arranging concentrically 1 or two or more cylindrical shape cels which were similarly formed in the outside of the cylindrical shape cel in which the fuel electrode was formed on any or another side so that it might become the bore which fits in loosely outside one by one After fitting in a cylindrical shape cel loosely concentrically by connecting electrically between each cylindrical shape cel arranged concentrically through the conductive member which has elasticity, in order to connect electrically by the conductive member which has elasticity, Since the conductive member which has elasticity between each cylindrical shape cel is **(ed) ** 1 while being able to form the multiplet structure easily, the differential thermal expansion between each cylindrical shape cel is absorbed, and breakage is prevented. Moreover, it can take out from one cylindrical shape cel by the high voltage. Furthermore, the miniaturization of a facility is attained, while rigidity becomes high and a modularization becomes easy by preparing two or more cylindrical shape cels in piles concentrically.

[0010]

[Example] The example of this invention is explained based on drawing 1 thru/or drawing 4 below.

[0011] Drawing 1 shows the 1st example of the cylinder product type fuel cell of this invention, and while this fuel cell 20 forms air electrode 21b of the porosity which becomes the inner skin of solid electrolyte 21a which formed yttria stabilized zirconia (YSZ) with oxygen ionic permeability in the cylindrical shape of a predetermined dimension from a perovskite mold lanthanum system oxide, the inside cel 21 of the cylindrical shape in which fuel electrode 21c which makes nickel etc. a subject was formed is formed in that peripheral face. And it consists of metals, such as nickel excellent in thermal resistance, and the interconnector 23 of the cylindrical shape which serves as a gas separator consists a predetermined gap between air electrode 21b formed in the peripheral face of the inside cel 21, and is concentrically arranged in the outside of this inside cel 21.

[0012] Furthermore, while forming porous air electrode 22b in the periphery of solid electrolyte 22a formed in the cylindrical shape of a major diameter from this interconnector 23 like said inside cel 21,

the outside cel 22 of the cylindrical shape in which fuel electrode 22c was formed consisted the predetermined gap between said interconnectors 23, and has fitted loosely into that inner skin concentrically at the periphery side of interconnector 23.

[0013] Moreover, while the conductive metal high connection member 24 of nickel etc. connects electrically between air electrode 21b of the periphery of the inside cel 21, and the inner skin of interconnector 23, it connects with the condition which can absorb a differential thermal expansion electrically by infixing the nickel felt 25 which has elasticity between the peripheral face of interconnector 23, and fuel electrode 22c of the inner circumference of the outside cel 22.

[0014] And the centrum of the inside cel 21 and the gap between interconnector 23 and the outside cel 22 serve as the fuel gas passage 26 which circulates fuel gas so that each fuel electrodes 21c and 22c may be contacted, and the gap between the inside cel 21 and interconnector 23 and the space of the periphery of the outside cel 22 circulate air, and serve as the oxidation gas passageway 27 so that each air electrodes 21b and 22b may be contacted.

[0015] Next, an operation of this example constituted as mentioned above is explained.

[0016] If the cylinder laminating mold fuel cell 20 which consists of an inside cel 21 and an outside cel 22 circulates air to the space of the outside of the oxidation gas passageway 27 and the outside cel 22 while supplying fuel gas to the fuel gas passage 26 and 26, respectively, the oxygen gas in the air which passed the porosity air electrodes 21b and 22b will serve as ion, and it will pass solid electrolytes 21a and 22a, and will reach the fuel electrode 21c and 22c side. And this oxygen ion makes these porosity fuel electrodes 21c and 22c generate electromotive force in the inside cel 21 and the outside cel 22 in response to an electrochemistry target with the hydrogen gas in the fuel gas which contacts and flows, respectively. And it connects with the outside cel 22 through the connection member 24, interconnector 23, and the nickel felt 24 at a serial, and the power generated in the inside cel 21 and the outside cel 22 is taken out by the high voltage.

[0017] Therefore, this cylinder laminating mold fuel cell 20 Since the inside cel 21 and the outside cel 22 are formed in one cylindrical shape, while being able to make generated power into the high voltage and being able to take it out In order to carry out the laminating of two or more single cells concentrically, rigidity is high, therefore it has an advantage, like the modularization which a majority of these cylinder laminating mold fuel cells 20 are gathered, and is unified becomes easy, and a small high increase in power becomes possible.

[0018] Moreover, while giving a predetermined gap to the outside of the inside cel 21, fitting the outside cel 22 loosely into it and forming interconnector 23 in said gap While connecting between interconnector 23 and air electrode 21b of the inside cel 21 by the connection member 24 Since it considered as the structure which infixes the nickel felt 25 which has elasticity between fuel electrode 22c of the outside cel 22, and is connected electrically While being able to manufacture easily this cylinder laminating mold fuel cell 20 Since the nickel felt 25 which has elasticity is infixed between the inside cel 21 and the outside cel 22, the differential thermal expansion between both the cels 21 and 22 is absorbed by the nickel felt 25, and can prevent generating of failure by breakage, a poor contact, etc. [0019] Moreover, although two cels which show the 2nd example of this invention, and formed the air electrode in the inner circumference of the solid electrolyte formed in the cylindrical shape in said 1st example, and formed the fuel electrode in the periphery, respectively were explained about the case where it fits in loosely concentrically, drawing 2 In this example, it is what carried out laminating formation concentrically, and three cylindrical shape cels, the inside cel which formed the air electrode inside each solid electrolyte formed in the cylindrical shape, and formed the fuel electrode outside, respectively, a central cel, and an outside cel, are explained based on a drawing below.

[0020] This fuel cell 30 that arranged concentrically three cylindrical shape cels from which the inside diameter of the inside cel 31, the central cel 32, and the outside cel 33 differs Leave the air electrodes 31b, 32b, and 33b by the side of inner circumference, and it notching-****. each of each cylindrical shape cels 31, 32, and 33 -- to a groove some of solid electrolytes 31a, 32a, and 33a and fuel electrodes 31c, 32c, and 33c The connector 36 is formed in the periphery side of each air electrodes 31b, 32b, and 33b at the fuel electrodes 31c, 32c, and 33c and a non-contact condition, respectively. And while giving

a predetermined gap between cells and arranging concentrically three cylindrical shape cells, the inside, a center, and an outside, 31, 32, and 33 in it, the interconnectors 34 and 34 of the cylindrical shape which served as the gas separator which consists of a cermet of nickel and a zirconia are electrically connected to each gap through the nickel felt 35 which has elasticity among the fuel electrodes 31c and 32c of the cylindrical shape cells 31 and 32 of the method of inside, respectively. Furthermore, it connects electrically through the connection member 37 of interconnectors 34 and 34 which consists between the air electrodes 32b and 33b of the cylindrical shape cells 32 and 33 of the method of outside of a heat-resistant metal, respectively.

[0021] And while the fuel gas passage 38 is formed [between fuel electrode 31c of the periphery of the inside cell 31, and interconnectors 34], respectively between fuel electrode 32c and the interconnectors 34 of an outside of the periphery of the central cell 32. The oxidation gas passageways 39 and 39 of each peripheral face of interconnectors 34 and 34, the central cell 32, and the outside cell 33 to which air is circulated between the air electrodes 32b and 33b of inner circumference, respectively are formed, respectively.

[0022] And the cylinder laminating mold fuel cell 30 constituted as mentioned above. The connector 36 which exposes fuel electrode 33c of the periphery of the outside cell 33 from a notching **** part. While being arranged by the condition which is connected to a serial by fuel electrode 33 minding [of the outside cell 33 of other cylinder laminating mold fuel cells 30 constituted similarly] the nickel felt 35, and can absorb a differential thermal expansion. In another adjoining cylinder laminating mold fuel cell 30, fuel electrode 33c of the periphery of each outside cell 33 and 33 and 33c are connected to juxtaposition through the nickel felt 35.

[0023] Next, an operation of this example constituted as mentioned above is explained.

[0024] The module connected to the serial parallel through the nickel felt 35 two or more cylinder laminating mold fuel cells 30 which consist of three cylindrical shape cells, the inside cell 31, the central cell 32, and the outside cell 33. While circulating air to each oxidation gas passageway 39 containing the center of the inside cell 31. If fuel gas is circulated to the space of each fuel gas passage 38 and the outside of the outside cell 33. The oxygen gas in the air which passed the porosity air electrodes 31b, 32b, and 33b serves as ion, solid electrolytes 31a, 32a, and 33a are passed, and the fuel electrodes [31] and 32c and 33c side is reached, respectively. And this oxygen ion makes these porosity fuel electrodes 31c, 32c, and 33c generate electromotive force in the inside cell 31, the central cell 32, and the outside cell 33 in response to an electrochemistry target with the hydrogen gas in the fuel gas which contacts and flows, respectively. And interconnector 35, a connector 36, and the connection member 37 connect with a serial, and the current generated, respectively in the inside cell 31, the central cell 32, and the outside cell 33 is taken out by the high voltage.

[0025] Therefore, the fuel cell 30 of the cylinder laminating mold of this example can make the high voltage generated power, and can take it out while rigidity becomes it is high, therefore easy [the modularization which gathers a majority of these fuel cells 30], since three cylindrical shape cells of the inside cell 31, the central cell 32, and the outside cell 33 were concentrically formed in one in piles.

[0026] Furthermore, while forming air electrode 41b of the porosity which drawing 3 shows the 3rd example of this invention, and a fuel cell 40 consists of an inside cell 41 and an outside cell 42, and becomes the inner skin of solid electrolyte 41a which formed yttria stabilized zirconia (YSZ) in the cylindrical shape from a perovskite mold lanthanum system oxide, cylindrical or the ring-like interconnector 43 of the porosity further for current collection to the inside of this air electrode 41b is formed. Moreover, fuel electrode 41c which makes nickel etc. a subject is formed in the peripheral face of said solid electrolyte 41a. And it consists of metals, such as nickel excellent in thermal resistance, and the interconnector 44 of the cylindrical shape which serves as a gas separator consists a predetermined gap between fuel electrode 41c formed in the peripheral face of the inside cell 21, and is concentrically arranged in the outside of this inside cell 41.

[0027] Furthermore, while the outside cell 42 formed in the cylindrical shape of a major diameter from this interconnector 44 forms porous air electrode 42b in the inner circumference of that solid electrolyte 42a like said inside cell 41, between said interconnectors 44, the outside cell 42 of the cylindrical shape in

which fuel electrode 42c was formed consists a predetermined gap, and is concentrically arranged in the periphery side of interconnector 44 by that peripheral face.

[0028] Moreover, between fuel electrode 41c of the periphery of the inside cel 41, and the inner skin of interconnector 44, while connecting with the condition which can absorb a differential thermal expansion electrically by infixing the nickel felt 45, the conductive metal high connection member 46 of nickel etc. connects electrically between air electrode 42b formed in the peripheral face of said interconnector 44, and the inner skin of the outside cel 42.

[0029] And the centrum of the inside cel 41 and the gap between interconnector 44 and the outside cel 42 serve as the oxidation gas passageway 47 which circulates air so that each air electrodes 41b and 42b may be contacted, and the gap between the inside cel 41 and interconnector 44 and the space of the periphery of the outside cel 42 circulate air, and serve as the fuel gas passage 46 so that each fuel electrodes 41c and 42c may be contacted.

[0030] And like the case of said 1st example, while circulating air to the oxidation gas passageways 47 and 47 of a fuel cell 40 If air is circulated to the space of the outside of the outside cel 42, and the fuel gas passage 46 and 46 between the inside cel 41 and interconnector 44 The oxygen gas in air serves as ion, solid electrolytes 41a and 42a are passed, and the inside cel 41 and the outside cel 42 are made to generate electromotive force in response to the hydrogen gas and the electrochemistry target in fuel gas in the porosity fuel electrodes 41c and 42c, respectively. And the current generated in the inside cel 41 and the outside cel 42 connects that of the inside cel 41 and the outside cel 42 to a serial through interconnector 44, the nickel felt 45, and the connection member 46, and is taken out by the high voltage like the case of the 1st example.

[0031] Moreover, drawing 4 shows the 4th example of this invention, and sets it in said each example. Arrangement with the fuel electrode, solid electrolyte, and air electrode which constitute a fuel cell to the inner skin of the solid electrolyte formed in the cylindrical shape a fuel electrode Moreover, two or more cylindrical shape cels from which the size by which the air electrode was formed in the peripheral face, respectively differs are set in this example to having arranged in piles concentrically. When it arranges concentrically, it is what was arranged so that each fuel electrodes of an inside cel and an outside cel or air electrodes might counter mutually, and based on a drawing, it explains below.

[0032] This fuel cell 50 consists of an inside cel 51 and an outside cel 52. Fuel electrode 51c is formed in the inner skin of solid electrolyte 51a by which the inside cel 51 was formed in the cylindrical shape in air electrode 51b at the peripheral face, respectively. Moreover, in the case of the outside cel 52, fuel electrode 52c is conversely formed in the inner skin of solid electrolyte 52a formed in the cylindrical shape, air electrode 51b is formed in a peripheral face, respectively, and the inner connector 53 further for current collection in the inside of air electrode 51b of the inner circumference of the inside cel 51 is formed.

[0033] Moreover, the connector 54 is formed in a notch and this notch part at the periphery side of air electrode 51b of the inside cel 51 at fuel electrode 51c and a non-contact condition in a part of solid electrolyte 51a and fuel electrode 51c. Moreover, in a part of solid electrolyte 52a and fuel electrode 52c, a connector 54 is formed in a notch at a groove, and is formed in this notch part at the inner circumference side of air electrode 52b of the outside cel 52 at fuel electrode 51c and a non-contact condition.

[0034] And while the outside cel 52 is arranged in the outside of the inside cel 51 and opposite arrangement of fuel electrode 51c of the periphery of the inside cel 51 and the fuel electrode 52c of the inner circumference of the outside cel 52 is carried out at the predetermined spacing, the connector 54 of the inside cel 51 and the connector 54 of the outside cel 52 are connected to juxtaposition through the nickel felt 55. And the gap between the inside cel 51 and the outside cel 52 serves as the fuel gas passage 56 to which fuel gas is supplied so that the fuel electrodes 51c and 52c by which opposite arrangement was carried out may be contacted, respectively and it may flow to them, and the space of the centrum of the inside cel 51 and the periphery of the outside cel 52 serves as the oxidation gas passageway 57 to which air circulates so that the air electrodes 51b and 52b may be contacted, respectively and it may circulate to them.

[0035] And while fuel gas is supplied to the fuel gas passage 56 of a fuel cell 50, when air is circulated to the oxidation gas passageways 57 and 57, the oxygen gas in air serves as ion, solid electrolytes 51a and 52a are passed, and the inside cell 51 and the outside cell 52 are made to generate electromotive force in response to the hydrogen gas and the electrochemistry target in fuel gas in the porosity fuel electrodes 51c and 52c, respectively. And each connector 54 of the inside cell 51 and the outside cell 52 and the nickel felt 55 arranged among 54 connect with juxtaposition, and the current generated in the inside cell 51 and the outside cell 52 is taken out as a current of high ampere.

[0036] Moreover, in this example, since it has arranged so that the fuel electrodes 51c and 52c of the inside cell 51 and the outside cell 52 may counter mutually, and what is necessary is just to circulate one kind of gas in the gap between both the cells 51 and 52, the gas separator needed in each example of said 1st [the], and 2 and 3 can be made unnecessary.

[0037] In addition, although the case where opposite arrangement of the fuel electrodes of two cells which adjoin concentrically in this example was carried out was explained, opposite arrangement of the air electrodes can be carried out, for example, also when [of the outside cell 52 of the fuel cell 50 of this example] a cylindrical shape cell is arranged further outside and it considers as the Mie structure, opposite arrangement of those air electrodes can be carried out, and it can carry out similarly.

[0038] Here, the example of the desirable mode in this invention is listed.

[0039] The cylinder laminating mold fuel cell characterized by connecting it electrically through the conductive member which has elasticity while an inside cylindrical shape cell and the cylindrical shape cell which adjoins the outside are concentrically arranged so that the fuel electrode of one cylindrical shape cell and the air electrode of the cylindrical shape cell of another side may counter through a gas separator.

[0040] The cylinder laminating mold fuel cell characterized by arranging concentrically the inside cylindrical shape cell and the cylindrical shape cell which adjoins the outside so that both the fuel electrodes or air electrodes of a cylindrical shape cell may counter.

[0041] The cylinder laminating mold fuel cell characterized by connecting it electrically through the conductive member which has elasticity while an inside cylindrical shape cell and the cylindrical shape cell which adjoins the outside arrange concentrically so that both the fuel electrodes or air electrodes of a cylindrical shape cell may counter.

[0042]

[Effect of the Invention] As explained, as mentioned above, the cylinder laminating mold fuel cell of this invention While consisting and arranging a predetermined gap concentrically, two or more cylindrical shape cells The fuel gas passage which circulates fuel gas possible [contact] to the fuel electrode of said cylindrical shape cell, Since the cylindrical shape cell which prepares the oxidation gas passageway which circulates oxidation gas possible [contact] to the air electrode of said cylindrical shape cell, and adjoins an inside cylindrical shape cell outside further, respectively was made into the structure electrically connected through the conductive member which has elasticity While being able to manufacture this cylinder laminating mold fuel cell easily, the differential thermal expansion between inside-and-outside cells is absorbed, and generating of failure by the poor contact at the time of the breakage and contraction at the time of heat expansion etc. can be prevented. Moreover, the rigidity of a cylindrical shape cell can be improved, and since the output of each cylindrical shape cell can be made high while the modularization which gathers a cylindrical shape cell becomes easy, the miniaturization and high increase in power of a generation-of-electrical-energy facility by the solid oxide fuel cell become possible.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the cross-section front view showing the cylindrical shape cel of the 1st example of the cylinder laminating mold fuel cell of this invention.

[Drawing 2] It is the cross-section front view showing the cylindrical shape cel of the 2nd example similarly.

[Drawing 3] It is the cross-section front view showing the cylindrical shape cel of the 3rd example similarly.

[Drawing 4] It is the cross-section front view showing the cylindrical shape cel of the 4th example similarly.

[Drawing 5] It is the cross-section front view of a stack showing an example of the conventional monotonous mold fuel cell.

[Drawing 6] It is the cross-section side elevation of the module in which an example of the conventional cylindrical fuel cell is shown.

[Description of Notations]

21 -- Inside cel 21a -- Solid electrolyte 21b -- Air electrode 21c -- Fuel electrode 22 -- Outside cel 22a -- Solid electrolyte 22b -- Air electrode 22c -- Fuel electrode 23 -- Interconnector 25 -- Nickel felt 26 -- Fuel gas passage 27 -- Oxidation gas passageway.

[Translation done.]

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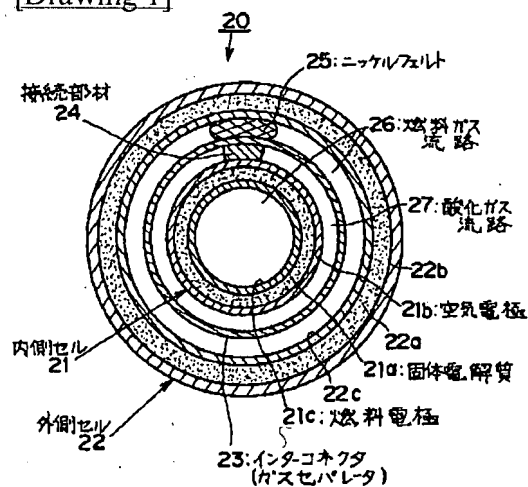
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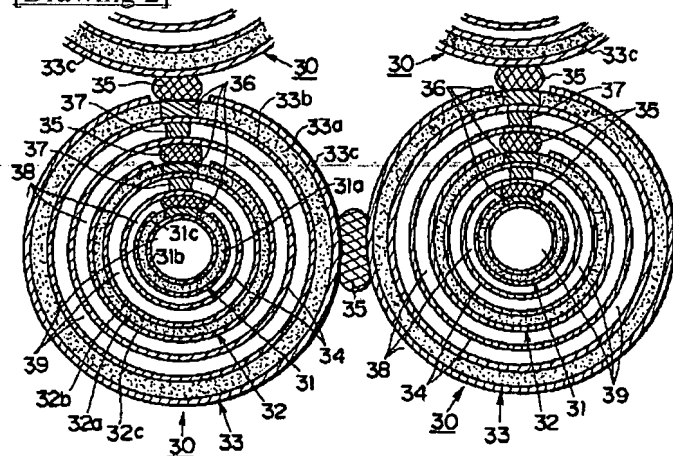
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DRAWINGS

[Drawing 1]



[Drawing 2]



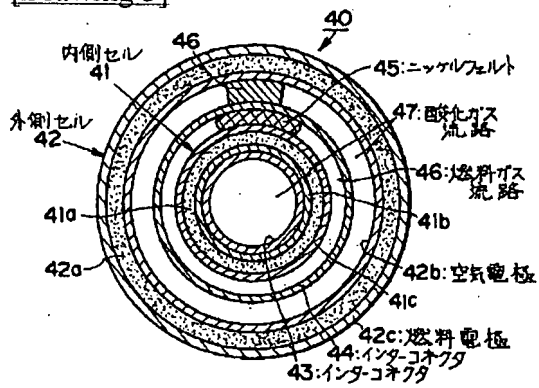
31: 内側セル
32: 中間セル
33: 外側セル
34: インターコネクタ

31a: 固体電解質
31c: 燃料電極

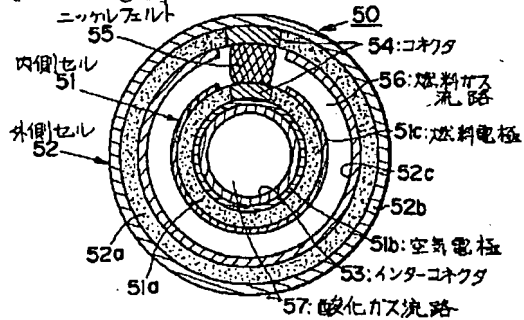
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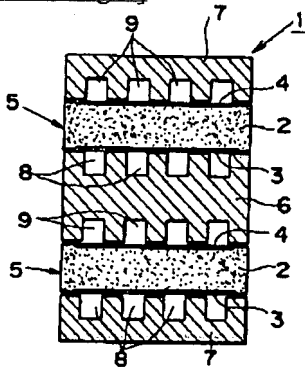
[Drawing 3]



[Drawing 4]



[Drawing 5]



[Drawing 6]

